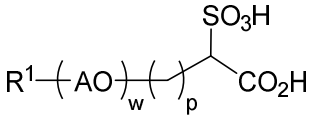
CLAIMS

1. A surfactant defined by Formula I below



Formula I

or a salt thereof, wherein

p is an integer from 1 to 5;

R^1 represents a C8-C50 alkyl group;

AO represents, individually for each occurrence, an alkyleneoxy group selected from an ethoxy group, a propoxy group, or a butoxy group; and

w is an integer from 1 to 110.

2. The surfactant of claim 1, wherein AO represents, individually for each occurrence, an alkyleneoxy group selected from an ethoxy group or a propoxy group.

3. The surfactant of any of claims 1-2, wherein w is an integer from 20 to 110, such as from 30 to 110, from 40 to 110, from 50 to 110, or from 60 to 110.

4. The surfactant of any of claims 1-3, wherein ε is defined by the formula below

$$\frac{w}{(q+p)} = \varepsilon$$

wherein

w and p are as defined above in Formula I; and

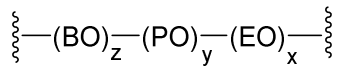
q is an integer equal to the number of carbon atoms in R^1; and

wherein ε is from 0.5 to 6, such as from 1 to 6, from 1.5 to 5, from 2 to 4.5, or from 2 to 4.

5. The surfactant of any of claims 1-4, wherein R^1 represents a branched C8-C50 alkyl group, such as a C8-C50 alkyl group derived from a Guerbet condensation reaction.

6. The surfactant of any of claims 1-5, wherein R^1 represents a linear C8-C50 alkyl group.

7. The surfactant of any of claims 1-6, wherein AO is defined by the formula below



wherein

BO represents a butyleneoxy group;

PO represents a propyleneoxy group;

EO represents an ethyleneoxy group;

x is an integer from 1 to 65;

y is an integer from 0 to 65; and

z is an integer from 0 to 45.

8. The surfactant of claim 7, wherein z is 0.

9. The surfactant of any of claims 7-8, wherein x is from 5 to 50, such as from 10 to 50, from 20 to 45, from 25 to 45, or from 25 to 40.

10. The surfactant of any of claims 7-9, wherein y is from 5 to 45, such as from 10 to 40, from 15 to 40, from 15 to 30, or from 15 to 25.

11. The surfactant of any of claims 7-10, wherein the ratio of x:(y+z) is from 0.5:1 to 2:1.

12. The surfactant of any of claims 7-10, wherein y is 0 and z is 0.

13. An aqueous composition comprising water and a surfactant defined by any of claims 1-12.

14. The composition of claim 13, wherein the composition further comprises one or more co-surfactants.

15. The composition of claim 14, wherein the one or more co-surfactants comprise an anionic surfactant, a non-ionic surfactant, a cationic surfactant, a zwitterionic surfactant, or any combination thereof;

wherein the anionic surfactant comprises a sulfonate, a disulfonate, a sulfate, a disulfate, a sulfosuccinate, a disulfosuccinate, a carboxylate, a dicarboxylate, or any combination thereof,

wherein the anionic surfactant comprises one of the following:

a branched or unbranched C6-C32:PO(0-65):EO(0-100)-carboxylate;

a C8-C30 alkyl benzene sulfonate (ABS);

a sulfosuccinate surfactant;

a surfactant defined by the formula below

$$R^1—R^2—R^3$$

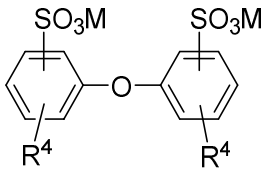
wherein

R^1 comprises a branched or unbranched, saturated or unsaturated, cyclic or non-cyclic, hydrophobic carbon chain having 6-32 carbon atoms and an oxygen atom linking R^1 and R^2;

R^2 comprises an alkoxylated chain comprising at least one oxide group selected from the group consisting of ethylene oxide, propylene oxide, butylene oxide, and any combination thereof; and

R^3 comprises a branched or unbranched hydrocarbon chain comprising 2-12 carbon atoms and from 2 to 5 carboxylate groups;

a surfactant defined by the formula below



wherein

R^4 is, individually for each occurrence, a branched or unbranched, saturated or unsaturated, cyclic or non-cyclic, hydrophobic carbon chain having 6-32 carbon atoms; and

M represents a counterion;

or any combination thereof;

wherein the non-ionic surfactant comprises a branched or unbranched C6-C32:PO(0-65):EO(0-100), such as a branched or unbranched C6-C30:PO(30-40):EO(25-35), a branched or unbranched C6-C12:PO(30-40):EO(25-35), or a branched or unbranched C6-C30:EO(8-30).

16. A method for treating a subterranean formation, the method comprising

introducing an aqueous composition defined by any of claims 13-15 through a wellbore into the subterranean formation.

17. The method of claim 16, wherein the method comprises a method for stimulating the subterranean formation that comprises:

(a) injecting the aqueous composition through the wellbore into the subterranean formation;

(b) allowing the aqueous composition to imbibe into a rock matrix of the subterranean formation for a period of time; and

(c) producing fluids from the subterranean formation through the wellbore.

18. The method of claim 16, wherein the method comprises a method for fracturing the subterranean formation that comprises:

(a) injecting the aqueous composition into the subterranean formation through the wellbore at a sufficient pressure to create or extend at least one fracture in a rock matrix of the subterranean formation in fluid communication with the wellbore.

19. The method of claim 16, wherein the wellbore comprises an injection wellbore, and wherein the method comprises a method for hydrocarbon recovery that comprises:

(a) injecting the aqueous composition through the injection wellbore into the subterranean formation; and

(b) producing fluids from a production wellbore spaced apart from the injection wellbore a predetermined distance and in fluid communication with the subterranean formation;

wherein injection of the aqueous composition increases a flow of hydrocarbons to the production wellbore.

20. A method of making a surfactant as defined in any one of claims 1-12, the method comprising:

alkoxylating a saturated alcohol having from 8 to 36 carbons to form an alkyleneoxy-tipped unsaturated alcohol;

reacting the alkyleneoxy-tipped saturated alcohol to form a saturated alkoxylated carboxylate; and

sulfonating the saturated alkoxylated carboxylate to form the surfactant.

21. The method of claim 20, wherein reacting the alkyleneoxy-tipped unsaturated alcohol comprises oxidizing the alkyleneoxy-tipped unsaturated alcohol to form the unsaturated alkoxylated carboxylate.

22. The method of claim 20, wherein reacting the alkyleneoxy-tipped unsaturated alcohol comprises carboxyalkylation of the alkyleneoxy-tipped unsaturated alcohol to form the unsaturated alkoxylated carboxylate.